GLUFOSINATE-AMMONIUM (158)

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EXPLANATION

Glufosinate-ammonium is a herbicide or desiccant. It was first evaluated for residues and toxicology by the 1991 JMPR and re-evaluated (T, R) by the 2012 JMPR. The ADI of glufosinate-ammonium was 0–0.01 mg/kg bw and the ARfD was 0.0 1mg/kg bw. The compound was listed by the 45th Session of CCPR for the JMPR to consider a revised use-pattern for use on soya bean. The residue definition for compliance with MRL and for estimation of dietary intake (for animal and plant commodities) is the sum of glufosinate, 3-[hydroxy(methyl)phosphinoyl]propionic acid and N-acetyl-glufosinate, calculated as glufosinate (free acid).

For the current evaluation the Meeting received critical data required for the estimation of MRLs for soya beans.

RESIDUE ANALYSIS

Stability of pesticide residues in stored analytical samples

The 2012 JMPR evaluated data on the storage stability of glufosinate-ammonium residues (and metabolites) in plant commodities that included soya bean. The studies concluded residues of glufosinate, NAG and MPP are stable under frozen conditions for at least 24 months in glufosinate-tolerant soya bean seed and for at least 12 months in glufosinate tolerant soya bean hay. The longest storage interval in the current trials was 5.4 months.

USE PATTERN

In the United States the registered use of glufosinate-ammonium for weed control in/on glufosinate-tolerant soya bean was recently amended. Up-dated information on the corresponding label recommendations and the supported use pattern is given in Table 1.

The critical GAP consists in two spray applications before the beginning of bloom, first at the rate of 0.74 kg ai/ha and then at the rate of 0.59 kg ai/ha with a minimum interval of 5 days between the two applications. The pre-harvest interval is 70 days.

The previous label suggested that it was possible to apply at the beginning of bloom and this point now has been specified since the growth stage at the time of application significantly impacts the residues in mature seed at harvest.

Table 1 GAP information on the use of glufosinate-ammonium in/on glufosinate-tolerant soya bean

Crop	Country	Use	Application			PHI
			Rate kg ai/ha	Spray volume L/ha	No.	
LLSoya bean	United States	Post-emergence and up to, but not including, the bloom growth stage	0.45-0.74 for 1st 0.45-0.59 for 2nd (max 1.3 kg ai/ha/season)	94-187 L/ha (> 94 L/ha air)	1-2	70[a]

[a] Do not graze the treated crop or cut for hay. Do not use nitrogen solutions as spray carriers. A silicone-based antifoam agent may be added if needed. Do not apply through any type of irrigation system. Sequential applications should be at least 5 days apart.

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

The Meeting received information on supervised residue trials of foliar treatments of glufosinate-ammonium for soya beans (Oakes 2013 TK011619).

Residues, application rates and spray concentrations have been rounded to two figures. Residue data are recorded unadjusted for percentage recoveries or for residue values in control samples. Where multiple analyses were conducted on a single sample, the average value is reported. Residues from the trials conducted according to critical GAP have been used for the estimation of maximum residue levels, STMR and HR values. Those results are underlined.

Table 2 Summary of sprayers, plot sizes and field sample sizes in the supervised trials

Crop	Location	Year	Sprayer	Plot size (m^2)	Sample size (kg)	Sample to analysis interval (months)
Soya	USA	2012	Backpack sprayer	56 m^2	≈2.3	4.9-5.0
Soya	USA	2012	Backpack sprayer	35 m^2	≈0.45	4.0-4.1
Soya	USA	2012	Backpack sprayer	74 m^2	≈2.3	5.1-5.2
Soya	USA	2012	Backpack sprayer	93 m^2	≈2.3	4.5-4.6
Soya	USA	2012	Tractor mounted sprayer	93 m^2	≈2.3	5.3-5.4
Soya	USA	2012	Tractor mounted sprayer	93 m^2	≈2.3	4.7-4.8

Six residue trials with glufosinate-tolerant soya bean (SYHT0H2 event) were conducted in the USA during the 2012 growing season. In each trial the treated plot received two applications of glufosinate-ammonium at the nominal rates of 0.74 kg ai/ha and 0.59 kg ai/ha, respectively, using an SL formulation. The first application was conducted at the growth stages BBCH 12–13 while the second application was conducted 7 to 15 days later, at the growth stages BBCH 14–59. Duplicate samples of soya bean seed were taken at the earliest commercial harvest which was between 86 and 110 days after the last application. Samples were stored frozen for a maximum of 5.4 months before analysis.

Table 3 Residues in glufosinate-tolerant soya bean (mean of replicate samples). Residues are expressed in glufosinate acid equivalents.

Location, year, variety	N (interval)	kg ai/ha	L/ha	GS (BBCH)	matrix	DAT	glufosinate	MPP	NAG	Total
Richland, IA, USA 2012 SYHT0H2 "Jack"	2 (39)	0.74 [a] 0.59 [a]	178 178	13 17	seed	104	0.074	0.022	0.20	<u>0.30</u>
Bagley, IA, USA 2012 SYHT0H2 "Jack"	2 (7)	0.74 [b] 0.65 [b]	178 178	13 15	seed	98	0.290	0.082	0.89	<u>1.3</u>
Cresco, IA, USA 2012 SYHT0H2 "Jack"	2 (9)	0.67 [a] 0.61 [a]	140 140	13 15-16	seed	97	0.058	0.132	0.17	<u>0.36</u>
Geneva, MN, USA 2012 SYHT0H2 "Jack"	2 (9)	0.74 [a] 0.58 [a]	178 168	12-13 14-15	seed	110	0.037	0.030	0.11	<u>0.18</u>
York, NE, USA 2012 SYHT0H2 "Jack"	2 (10)	0.75 [c] 0.59 [c]	187 178	12-13 49-50	seed	86	0.017	0.022	0.044	<u>0.08</u>
Stewardson, IL, USA 2012 SYHT0H2 "Jack"	2 (15)	0.87 [a] 0.60 [a]	159 140	12-13 59	seed	96	0.070	0.072	0.24	0.38

DAT = days after last application

MPP = 3-methyl-phosphinico-propionic acid; NAG = N-acetyl-L-glufosinate.

[a] +ammonium sulphate

[b] + NIS 0.25% v/v

[c] + NIS 0.25% v/v, 2.54 cm overhead irrigation 1 day after application

Table 4 Residues of glufosinate in soya bean seeds from glufosinate-tolerant soya bean in trials reported by the 2012 JMPR and matching the revised US GAP (note all trial locations included application rates that matched GAP, however, for locations where lower application rates were also studied, only the treatment that gave the highest residue is reported below) Residues are expressed in glufosinate acid equivalents

Location, year variety	Application No [a]	kg ai/ha	L/ha	GS [b]	DAT	Residue (mg/kg) glufosinate	MPP	NAG	Total	Reference
Chula USA 2009 S080120	2 (7)	0.73 0.59	160 160	14	123	< 0.01	0.01	0.03	0.04	RAGLP034 +AMS/NIA
Blackville USA 2009 SG4489NLL	2 (6)	0.73 0.60	160 160	14	111	< 0.01	0.02	0.06	0.08	
Proctor AR USA 2009 SG4489NLL	2 (16)	0.45 0.45	140 140	15	79	0.04	0.02	0.33	0.39	
Greenville USA 2009 S080120	2 (9)	0.73 0.59	130 120	15	105	0.06	0.06	0.28	0.40	RAGLP034 +AMS/NIA
Cheneyville USA 2009 S080120	2 (12)	0.75 0.60	150 150	16	85 100 110 120 125	0.04 0.04 0.04 0.06 0.06	0.02 0.02 0.03 0.03 0.03	0.45 0.31 0.36 0.32 0.34	0.51 0.37 0.43 0.41 0.43	RAGLP034 +AMS
Springfield USA 2009 S070139	2 (5)	0.73 0.61	130 130	14	78 95 104 112 118	< 0.01 0.01 < 0.01 0.02 < 0.01	0.04 0.06 0.07 0.05 0.06	0.07 0.14 0.11 0.15 0.11	0.11 0.21 0.18 0.22 0.17	RAGLP034 +AMS
Bagley IA USA 2009 S080141	2 (14)	0.45 0.45	160 160	15	76	0.06	0.04	0.99	1.09	RAGLP034 +AMS/NIA
Berkley USA 2009 S080141	2 (8)	0.44 0.45	170 160	14	85	0.02	0.04	0.44	0.50	
Geneva MN USA 2009 S080117	2 (10)	0.73 0.60	170 170	14	98	0.02	0.22	0.51	0.75	RAGLP034 +AMS/NIA
Campbell USA 2009 S080119	2 (11)	0.73 0.60	190 190	14	107	0.02	0.02	0.28	0.32	RAGLP034 +AMS
York NE USA 2009 S070139	2 (11)	0.73 0.59	140 140	14	93	0.04	0.07	0.54	0.65	RAGLP034 +AMS
Gardner USA 2009 S070144	2 (6)	0.74 0.61	140 140	14	98	0.02	0.02	0.14	0.18	RAGLP034 +AMS/NIA
Richland IA USA 2009 S070144	2 (15)	0.46 0.45	180 190	15	102	0.01	0.02	0.16	0.19	
Richwood USA 2009 S0701344	2 (8)	0.74 0.45	160 160	14	106	<0.01	0.02	0.08	0.10	
Marysville USA 2009 S0701344	2 (8)	0.45 0.45	170 160	14	106	0.01	0.05	0.26	0.32	
Clarence USA 2009 S070146	2 (7)	0.74 0.59	190 180	14	104	0.01	0.05	0.26	0.32	RAGLP034 +AMS
Lime Springs USA 2009 S080119	2 (10)	0.77 0.59	200 180	14	127	0.03	0.06	0.36	0.45	RAGLP034 +AMS/NIA
Cherry Grove USA 2009 S080119	2 (12)	0.75 0.46	190 190	14	117	0.04	0.04	0.46	0.54	
Seymour USA 2009 S070141	2 (6)	0.67 0.60	160 180	14	82	0.04	0.04	0.22	0.30	RAGLP034 +AMS

DAT = days after last application

[a] interval between treatments

[b] Soya beans, BBCH growth stages (Meier, 2001)

14 Trifoliate leaf on the fourth node unfolded.

15 Trifoliate leaf on the fifth node unfolded.

16 Trifoliate leaf on the sixth node unfolded.

APPRAISAL

Glufosinate-ammonium is a herbicide or desiccant. It was first evaluated for residues and toxicology by the 1991 JMPR and re-evaluated (T, R) by the 2012 JMPR. The ADI of glufosinate-ammonium was 0–0.01 mg/kg bw and the ARfD was 0.0 1mg/kg bw. The compound was listed by the 45th Session of CCPR for the JMPR to consider residues in soya bean following a revision to the use-pattern.

The residue definition for compliance with MRL and for estimation of dietary intake (for animal and plant commodities) is the sum of glufosinate, 3-[hydroxy(methyl)phosphinoyl]propionic acid and N-acetyl-glufosinate, calculated as glufosinate (free acid).

For the current evaluation the Meeting received critical data required for the estimation of MRLs for soya beans.

Stability of residues in stored analytical samples

The 2012 JMPR evaluated data on the storage stability of glufosinate-ammonium residues (and metabolites) in plant commodities that included soya bean. The studies concluded residues of glufosinate, NAG and MPP are stable under frozen conditions for at least 24 months in glufosinate-tolerant soya bean seed and for at least 12 months in glufosinate tolerant soya bean hay. The longest storage interval in the current trials was 5.4 months.

Results of supervised residue trials in crops

Soya beans, tolerant

The Meeting received field trials performed in the USA involving glufosinate tolerant soya beans. GAP for USA is for (1) one application pre-planting or pre-emergence at 0.59–0.74 kg ai/ha with additional applications from post-emergence to the early bloom growth stage at 0.45–0.59 kg ai/ha with a maximum seasonal rate of 1.3 kg ai/ha/year or (2) post-emergence only with applications from post-emergence to the early bloom growth stage at 0.41–0.50 kg ai/ha with a maximum seasonal rate of 0.91 kg ai/ha/year. The PHI is 70 days. Post-emergent application leads to higher residues.

The use pattern specifies both a last growth stage for application (before the bloom growth stage) and a PHI. The Meeting noted that the interval between the last application and harvest varies significantly depending on the trial location and the soya bean cultivar and that the growth stage at last application was the critical parameter in determining compliance with GAP rather than the PHI.

In trials previously reported by the 2012 JMPR and new trials made available to the current meeting approximating the revised critical GAP in the USA total residues (glyphosate+NAG+MPP) in soya bean seeds were (n=24): 0.04, 0.08, 0.08, 0.1, 0.18, 0.18, 0.19, 0.22, 0.3, 0.3, 0.32, 0.32, 0.32, 0.36, 0.39, 0.4, 0.45, 0.5, 0.51, 0.54, 0.65, 0.75, 1.09, 1.3 mg/kg. The Meeting estimated a median residue of 0.32 mg/kg for use in calculating livestock dietary burdens and a maximum residue level of 2 mg/kg for soya bean, dry to replace its previous recommendation of 3 mg/kg.

Residues for estimation of dietary intake (glufosinate + 0.1×[NAG+MPP]) residues were (n=24): 0.02, 0.02, 0.03, 0.04, 0.05, 0.05, 0.07, 0.08, 0.09, 0.09, 0.09, 0.09, 0.09, 0.10, 0.11, 0.11, 0.13, 0.13, 0.14, 0.14, 0.19, 0.25, 0.35 and 0.39 mg/kg. The Meeting estimated an STMR and HR of 0.09 and 0.39 mg/kg respectively for soya bean (dry) for use in calculation of dietary intake.

Fate of residues during processing

Processing factors reported by the 2012 JMPR are used to calculate median residues for aspirated grain fractions, hulls, meal and oil that are used in calculation of livestock dietary burden and also for oil used in calculation of the IEDI and IESTI for glufosinate-ammonium.

Summary of selected processing factors for glufosinate-ammonium

Raw commodity	Processed commodity	Individual PF	Best estimate PF	Median or $STMR_{RAC}$ (mg/kg)	Median or $STMR_{RAC}$ × PF (mg/kg)
Soya bean	Aspirated grain fraction	2.73 8.89	5.81	0.32	1.86
	Hulls	3.15, 11.4	7.275		2.33
	Meal	1.22	1.22		0.39
	Oil	< 0.11 < 0.12 <0.22 < 0.9	< 0.17	0.09	< 0.015

Animal commodity maximum residue levels

The minor changes to the estimated soya bean and soya bean processed commodity levels do not result in significant differences in livestock dietary burdens. The Meeting agreed it is not necessary to make new estimates and recommendations for livestock commodities.

RECOMMENDATIONS

On the basis of the data obtained from supervised residue trials the Meeting concluded that the residue levels listed below are suitable for establishing maximum residue limits and for IEDI and IESTI assessment.

Definition of the residue for (compliance with the MRL and for estimation of dietary intake) for animal and plant commodities: *sum of glufosinate, 3-[hydroxy(methyl)phosphinoyl]propionic acid and N-acetyl-glufosinate, calculated as glufosinate (free acid)*

The residue is not fat soluble.

Table of recommendations.

Commodity		Recommended MRL (mg/kg)		STMR or STMR-P (mg/kg)	HR (mg/kg)
CCN	Name	New	Previous		
VD 0541	Soya bean (dry)	2	3	0.09	-

DIETARY RISK ASSESSMENT

Long-term intake

The Meeting noted that the reduction in the recommended maximum residue level for soya beans would result in lower IEDIs than those previously estimated for glufosinate-ammonium by the 2012 JMPR. The present meeting concluded that the long-term intake of glufosinate-ammonium resulting from the uses considered by the current JMPR is unlikely to present a public health concern.

Short-term intake

The WHO Panel of the 2012 JMPR established an Acute Reference Dose (ARfD) of 0.01 mg/kg bw for glufosinate-ammonium. The IESTI was calculated for soya bean and related commodities using STMR, STMR-P and HR values estimated by the current Meeting. The IESTIs represented 0 to 10% of the ARfD of 0.01 mg/kg bw. The Meeting concluded that the short-term intake of residues of glufosinate-ammonium resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

REFERENCES

Code	Author	Year	Title, Institute & report number, Submitting manufacturer and report code, GLP/Non-GLP. Published/Unpublished
RAGLP034 M-388245-01-1	Fischer, DR	2010	Fischer DR. 2010 Ignite 280 SL–Magnitude of the residue in/on soybean. Bayer CropScience Report No. RAGLP034. Bayer CropScience AG Edition No. M-388245-01-1. Unpublished.
	Meier	2001	Meier U (ed.) 2001 BBCH Monograph: Growth stages of mono- and dicotyledonous plants, Federal Biological Research Centre for Agriculture and Forestry, http://www.bba.de/veroeff/bbch/bbcheng.pdf
TK011619	Oakes	2013	Oakes TL. 2013 Magnitude of the residues in or on herbicide tolerant soybean (Event SYHT0H2) Syngenta Crop Protection, Inc., Greensboro, NC, USA Syngenta, Report No.: TK011619, Edition Number: M-470537-01-1 Date: 2013-11-06, unpublished.